Colorado Coordinated Planning Group
Colorado Energy Plan Task Force

Public Service Company of Colorado

March 1, 2019

Agenda

- Introductions
- Antitrust Reminder
- CEP/ERP Update
- Study Update
  - Voltage Control
  - Network Upgrades
- Schedule
- Next Steps

Antitrust Reminder

It should be the policy and practice (Policy) of the parties participating in the Colorado Coordinated Planning Group to obey the antitrust laws and avoid all conduct that unreasonably restrains competition. Under this Policy, participants should avoid any conduct or behavior that violates, or that might appear to violate, the antitrust laws. Among other things, the antitrust laws forbid any agreement between or among competitors regarding prices, availability of service, product design, terms of sale, division of markets, allocation of customers or any other activity that unreasonably restrains competition.

ERP/CEP Update

Background

- **PSCo 2016 Electric Resource Plan (ERP)**
  - **Filed May 2016**
- **PSCo Colorado Energy Plan (CEP)**
  - **Filed August 2017**
- **120 Day Report**
  - **Filed June 2018**
- **PUC Approval of CEP Portfolio (CEPP)**
  - **Sep 2018**

Preferred CEP Portfolio

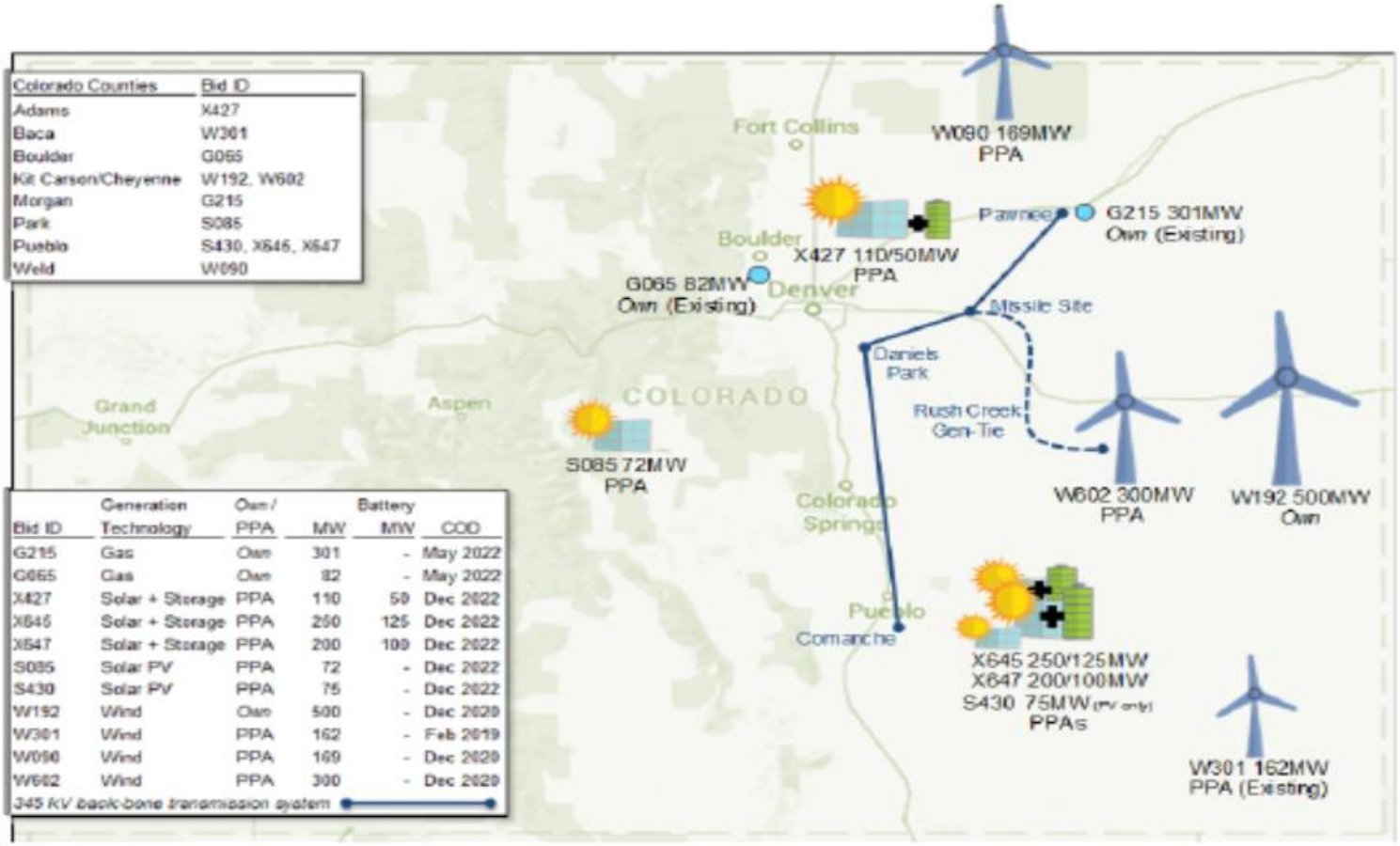
Table 9 - Preferred CEPP Projects

Bid ID	Project Name	Technology	MW	Ownership	In-Service
X645	[redacted]	Solar w/ Storage	250/125	IPP	2023
X647		Solar w/ Storage	200/100	IPP	2023
X427		Solar w/ Storage	110/50	IPP	2023
S430		Solar	75	IPP	2023
S085		Solar	72	IPP	2023
W192		Wind	500	Own	2021
W602		Wind	300	IPP	2021
W090		Wind	169	IPP	2021
W301		Wind (repower)	162	IPP	2019
G215		Gas (existing)	301	Own	2022
G065		Gas (existing)	82	Own	2022

Note: In-Service refers to the first summer the unit is available.

CEPP Map

Figure 5 - Preferred CEPP Generation Locations



CPCN Activity

- **Wind**
  - **Shortgrass Switching Station**
    - **Filed: Dec 5, 2018**
    - **Granted: Feb 14, 2019**
  - **Cheyenne Ridge Project**
    - **Filed: Dec 21, 2018**
    - **Status: On-going**

Study Update

Zinn Photography/Courtesy of SunEdison

CEPP Planning Activities

- **Gen-tie Reliability**
  - **Voltage Control**
- **Transmission Plan**
  - **(Network Upgrades)**
- **CPCN Participation**

Gen-Tie Reliability Studies

Zinn Photography/Courtesy of SunEdison

Gen-tie Concerns

- **Transient**
  - **Need to Maintain Transient Stability**
    - Loss of Gen-tie is Most Severe Single Contingency
    - Loss of other Network Elements
- **Voltage**
  - **Low Gen-tie Generation → Potential High Voltage**
  - **High Gen-tie Generation → Potential Low Voltage**
    - Wind Facility Power Factor Considerations
  - **Static vs. Dynamic Mitigation**
- **Network Upgrades**
  - **High Renewable Penetration →Potential Thermal Overloads**

Transient Studies

Transient Stability Studies

1. Rush Creek Task Force
   - Report Issued 2017
   - Benchmark Modeled Planned Gen-tie Configuration
   - Studied Loss of Gen-tie AND 1600 MW Generation
   - Conclusion: SYSTEM STABLE
2. Ultra High Penetration (UHP)
   - Internal Study
   - Reduced Conventional Generation in PSCo BA
   - Reduced Conventional Gen in Neighboring BA
     - Craig, Hayden, LRS, CSU
   - Conclusion: Need 1000-1200 MW of Conventional Gen
3. Mitsubishi
   - “Frequency Excursion Analysis”
   - Studied Loss of Gen-tie AND 1400 MW Generation
   - Conclusion: SYSTEM STABLE

Voltage Studies

CEPP Dispatch Assumptions

- **Coal:**
  - **Pawnee @ min**
  - **Comanche @ max**
- **Gas:**
  - **Fountain Valley 50%**
  - **Manchief Off**
  - **Metro Gas Used for Balance (Low)**
    - **Note – Maintain Gen @ FSV & Cher 4**
- **Wind:**
  - **Missile/Pawnee (NE System) @ 100%,**
  - **Other Wind @ 80%**

Voltage (Reactive) Results

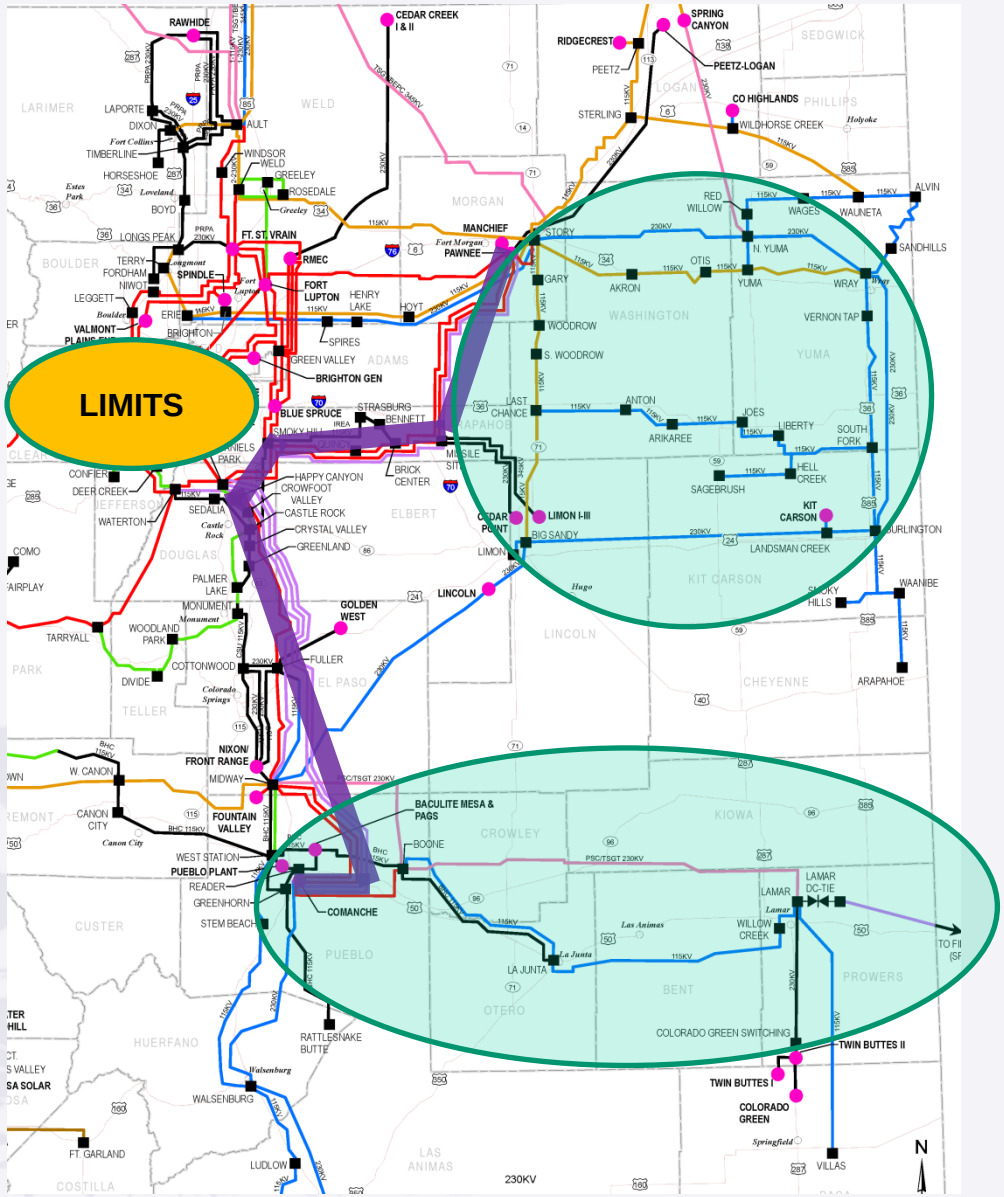
- **Low Gen**
  - 60 MVARs Shunt Reactance Recommended
    - Locate @ Shortgrass
- **High Gen**
  - 570 MVARs Shunt Capacitance Recommended
    - Pronghorn 345kV: 90 MVAR
    - Missile Site 345 kV: 250 MVAR
    - Harvest Mile 345 kV: 115 MVAR
    - Daniels Park 345 kV: 115 MVAR
- **Dynamic**
  - +/- 50 MVAR SVC Recommended
    - Locate @ Pronghorn

Network Upgrade Studies

Network Upgrade Studies

- Objective:
  - Accommodate CEPP
  - Develop Plan for Denver-metro System
- Methodology
  - Use System-wide Dispatch:
    - Remove Comanche 1 & 2
    - Model CEPP Generation at 100% Nameplate
    - Model Existing / Planned Wind at 80% Nameplate
    - Model Existing / Planned Solar at 85% Nameplate
    - Balance by Reducing Gas Fleet

map

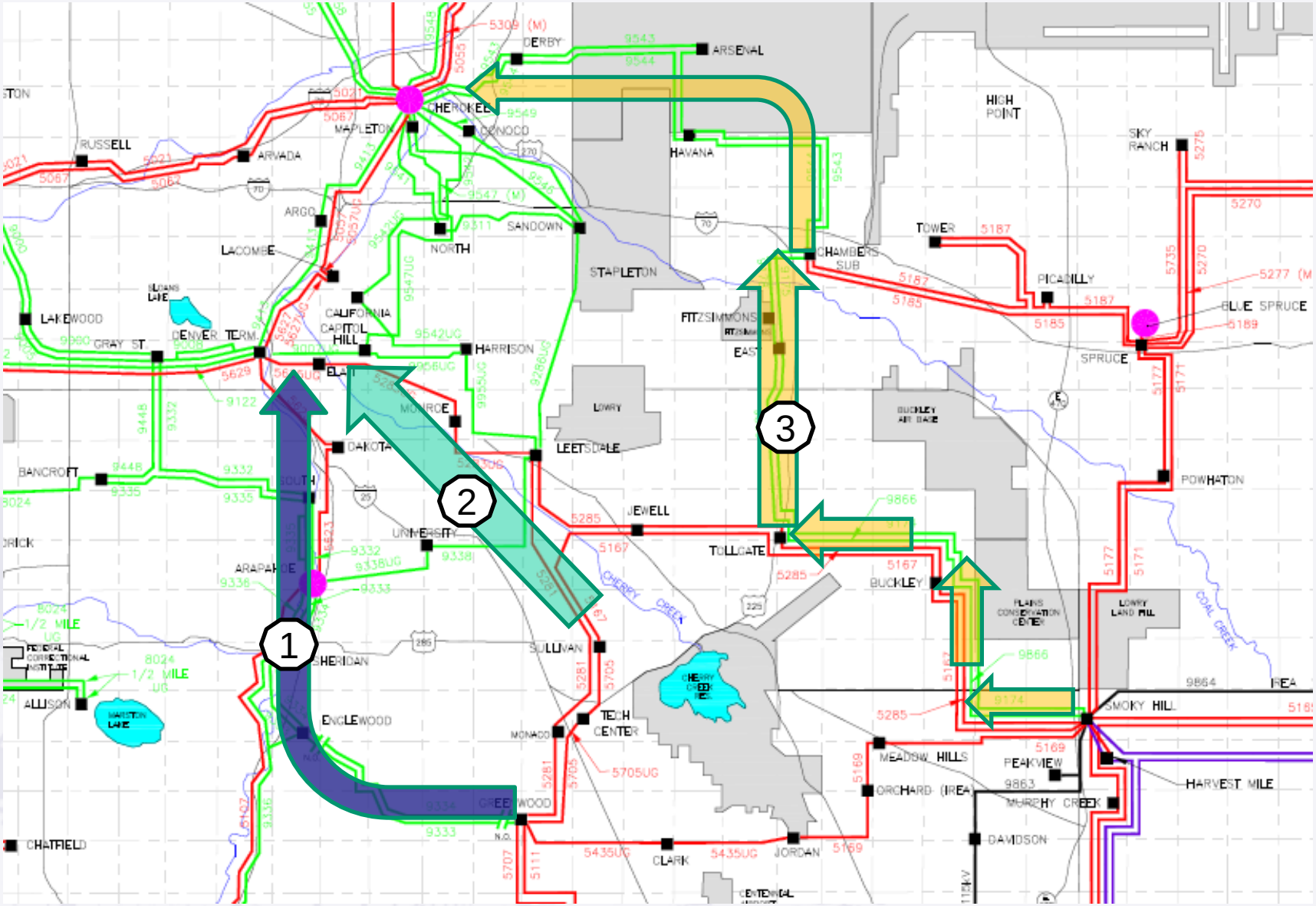

LIMITS
RAWHIDE
CEDAR CREEK I & II
RIDGECREST
SPRING CANYON
PEETZ
PEETZ-LOGAN
STERLING
CO HIGHLANDS
WILDHORSE CREEK
LARIMER
WELD
LOGAN
PHILLIPS
SEDGWICK
LAPORTE
DIXON
AULT
TIMBERLINE
WINDSOR
WELD
GREELEY
HORSESHOE
ROSEDALE
BOYD
LONGS PEAK
FT. ST. VRAIN
RMEC
MANCHIEF
PAWNEE
MORGAN
BOULDER
TERRY
FORDHAM
NIWOT
SPINDLE
FORT LUPTON
HENRY LAKE
HOYT
LEGGETT
ERIE
VALMONT
BRIGHTON
SPIRES
GREEN VALLEY
ADAMS
BRIGHTON GEN
BLUE SPRUCE
STRASBURG
BENNETT
SMOKY HILL
IREA
MISSILE SITE
BRICK CENTER
CONIFER
DEER CREEK
HAPPY CANYON
CROWFOOT VALLEY
CASTLE ROCK
CRYSTAL VALLEY
GREENLAND
SEDALIA
WATERTON
JEFFERSON
DOUGLAS
ELBERT
CHEYENNE
ARAPAHOE
LINCOLN
PALMER LAKE
MONUMENT
WOODLAND PARK
TARRYALL
COTTONWOOD
DIVIDE
FULLER
GOLDEN WEST
TELLER
EL PASO
PARK
COMO
PAIRPLAY
NIXON
FRONT RANGE
MIDWAY
W. CANON
CANON CITY
FOUNTAIN VALLEY
WEST STATION
PUEBLO PLANT
READER
GREENHORN
STEM BEACH
COMANCHE
PUEBLO
CUSTER
HUERFANO
RATTLESNAKE BUTTE
WALSENBURG
LUDLOW
FT. GARLAND
COSTILLA
LAS ANIMAS
BACULITE MESA & PAGS
BOONE
CROWLEY
KIOWA
OTERO
BENT
PROWERS
LA JUNTA
LAMAR
LAMAR DC-TIE
WILLOW CREEK
COLORADO GREEN SWITCHING
TWIN BUTTES II
TWIN BUTTES I
COLORADO GREEN
VILLAS
TO FII (SF
ALVIN
WAGES
WAUNETA
SANDHILLS
RED WILLOW
N. YUMA
STORY
GARY
AKRON
OTIS
YUMA
WRAY
WASHINGTON
WOODROW
S. WOODROW
VERNON TAP
YUMA
LAST CHANCE
ANTON
ARIKAREE
JOES
LIBERTY
SOUTH FORK
HELL CREEK
SAGEBRUSH
KIT CARSON
CEDAR POINT
LIMON I-III
BIG SANDY
LIMON
LANDSMAN CREEK
BURLINGTON
WAANIBE
SMOKY HILLS
KIT CARSON
Hugo
230KV
N

Recommended Metro Upgrades

- **Must do:**
  - Upgrade Leetsdale-Monaco 230 kV line
  - Replace limiting substation equipment Greenwood-Monaco
  - Replace limiting substation equipment Daniels Park-Greenwood
  - Cost Relatively Minor ($1-2 million)

- **Alternatives:**
  - Alt 1: New Greenwood-Arapahoe-Denver Terminal 230 kV Line
  - Alt 2: Rebuild or Replace:
    - Greenwood – Monaco 230 kV
    - Leetsdale – Monaco 230 kV
    - Leetsdale – Monroe 230 kV
    - Smoky Hill – Buckley – Tollgate 230 kV
  - Alt 3: Smoky Hill – Cherokee 230 kV Conversion

Network Upgrade Alternatives Map



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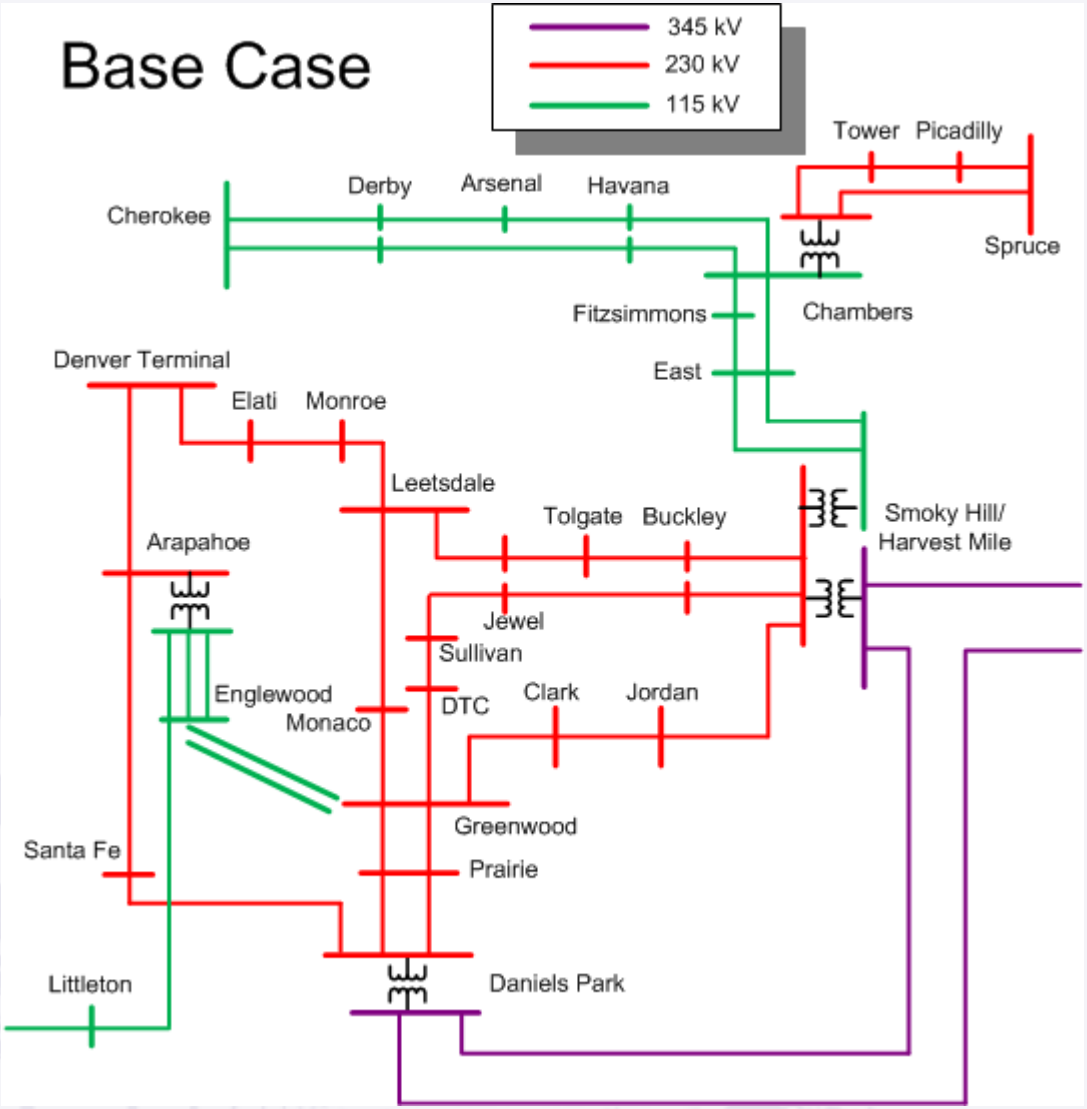
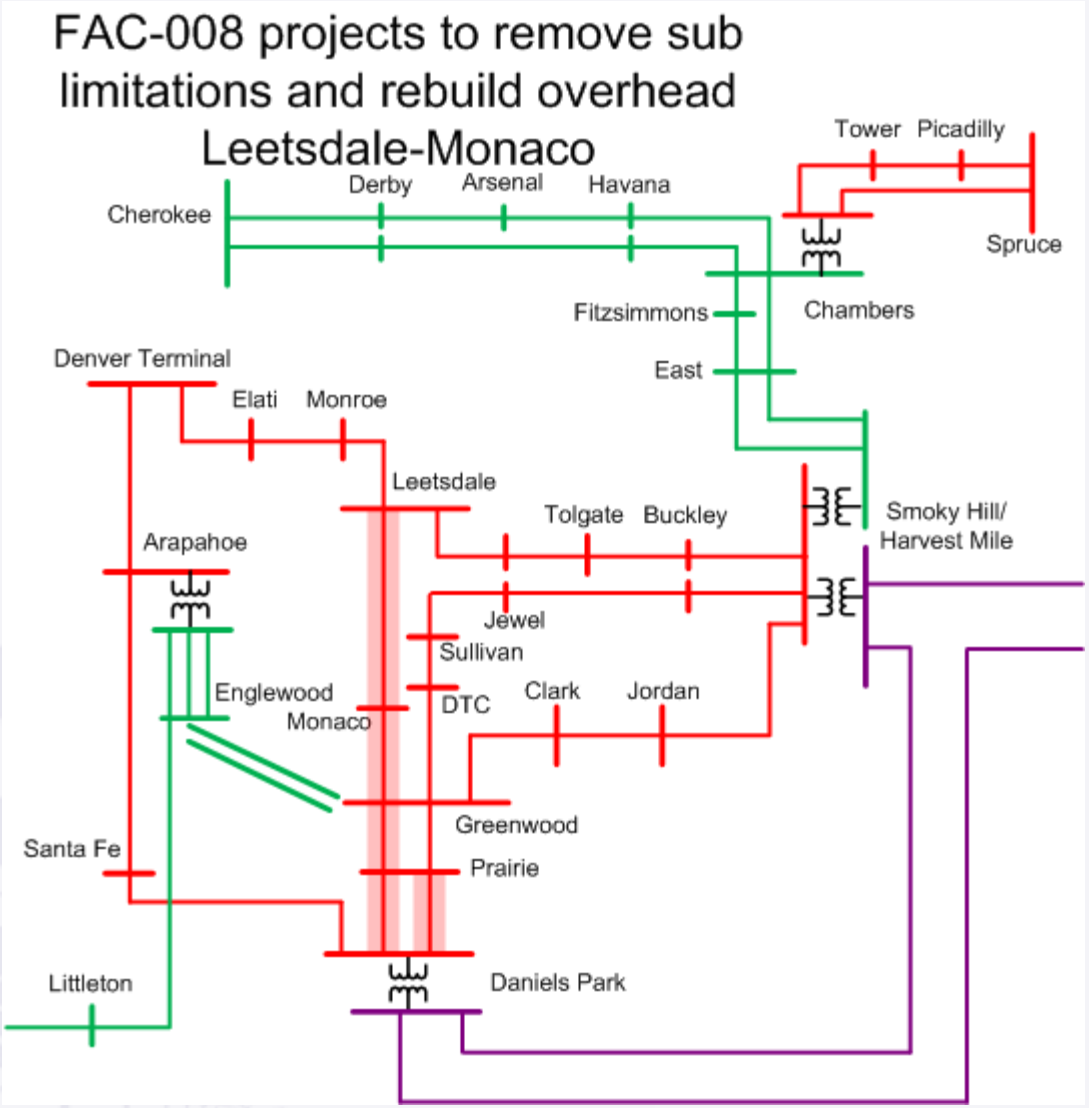
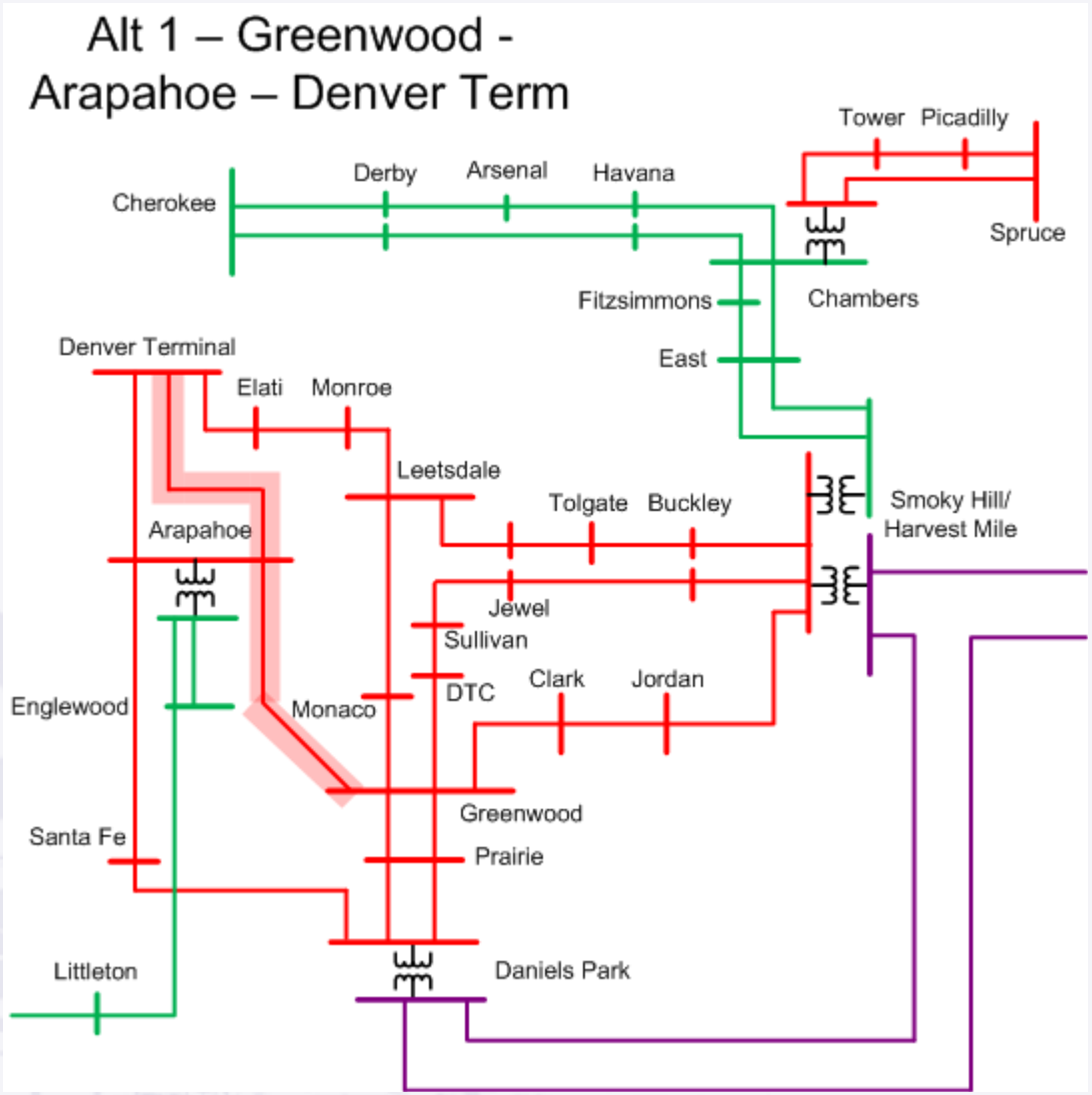
Base Case


Base Case
345 kV
230 kV
115 kV
Tower
Picadilly
Derby
Arsenal
Havana
Cherokee
Spruce
Fitzsimmons
Chambers
East
Denver Terminal
Elati
Monroe
Leetsdale
Tolgate
Buckley
Smoky Hill/
Harvest Mile
Arapahoe
Jewel
Sullivan
Englewood
Monaco
DTC
Clark
Jordan
Greenwood
Santa Fe
Prairie
Littleton
Daniels Park

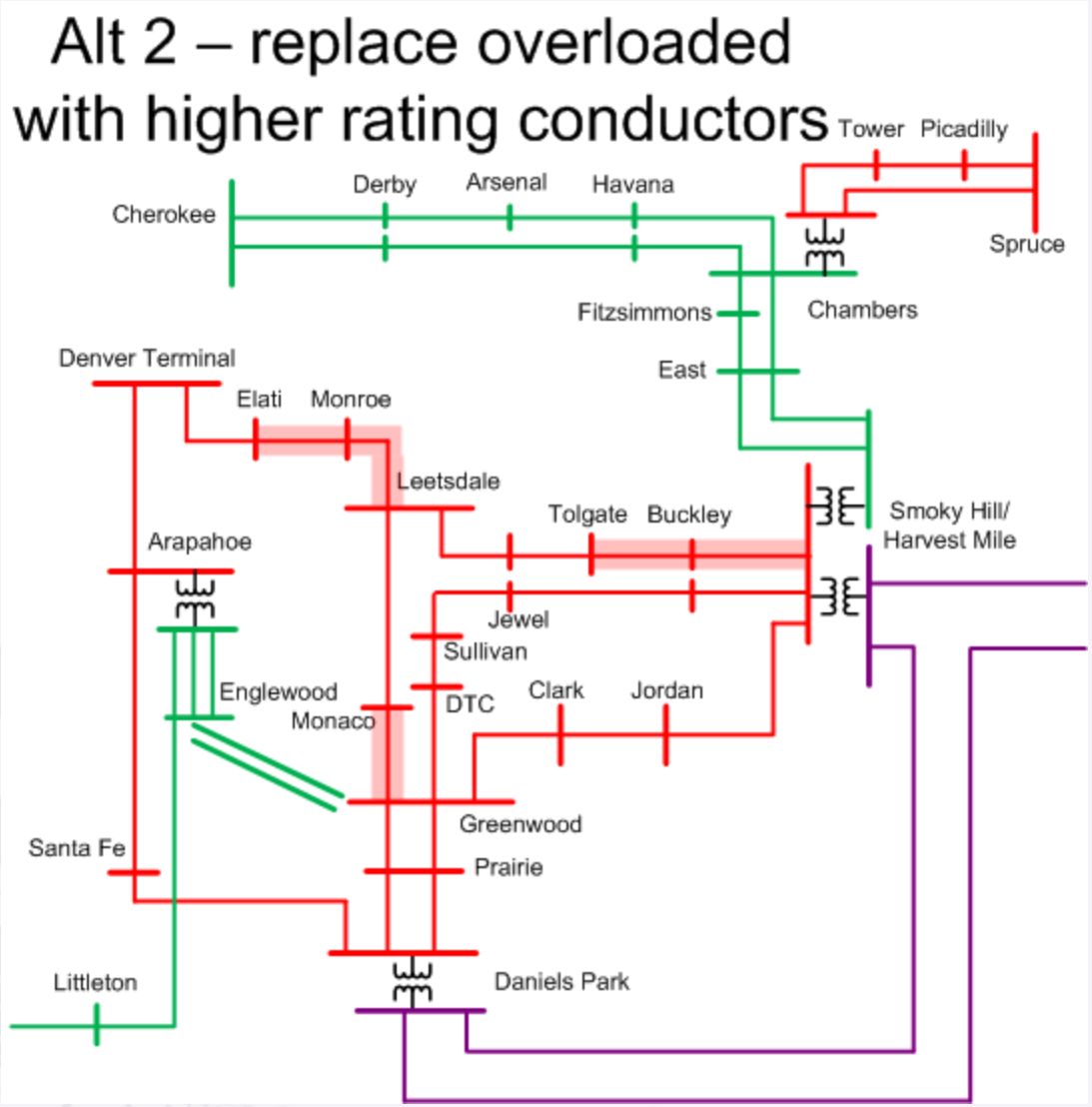
Must Do


FAC-008 projects to remove sub limitations and rebuild overhead Leetsdale-Monaco
Tower
Picadilly
Derby
Arsenal
Havana
Cherokee
Spruce
Chambers
Fitzsimmons
East
Denver Terminal
Elati
Monroe
Leetsdale
Tolgate
Buckley
Smoky Hill/
Harvest Mile
Arapahoe
Jewel
Sullivan
Englewood
Monaco
DTC
Clark
Jordan
Greenwood
Santa Fe
Prairie
Littleton
Daniels Park

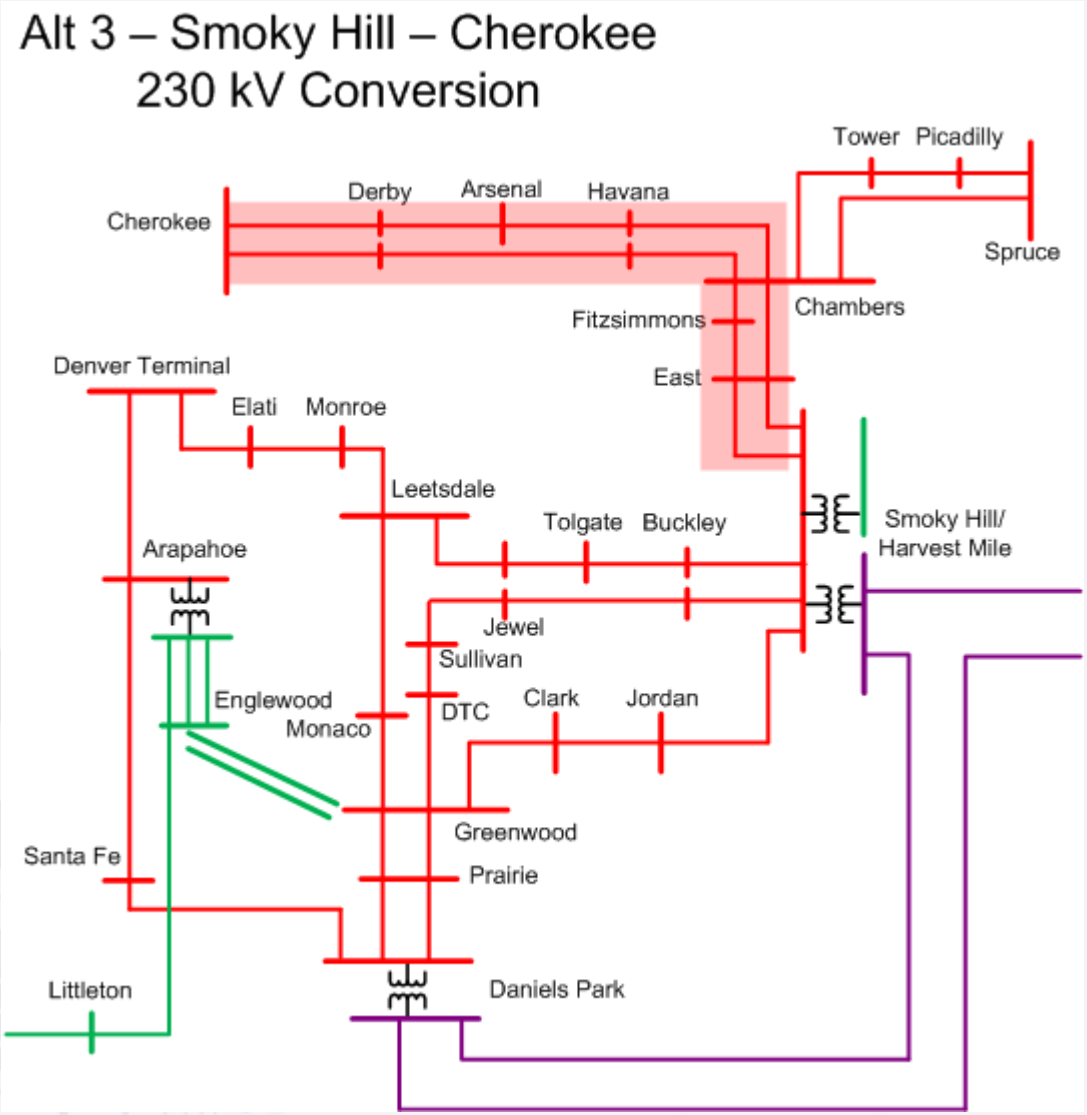
Alternative 1 - Recommended



Alternative 2



Alternative 3



Next Steps

- **Voltage Control**
  - **Fine Tune Recommendations**
  - **Cost Estimates / Schedules**
  - **Study Report**
  - **Notify Stakeholders & Commission**

- **Network Upgrades**
  - **Cost Estimates / Schedules**
  - **Determine Final Recommendation**
  - **Study Report**
  - **Notify Stakeholders & Commission**
  - **File CPCN**

Resources

- **Links:**
  - **CCPG**
    - http://regplanning.westconnect.com/ccpg.htm
  - **CEPTF**
    - http://regplanning.westconnect.com/ccpg_ceptf.htm
  - **ERP / CEP Information**
    - https://www.xcelenergy.com/company/rates_and_regulations/resource_plans
- **Email:**
  - **Tom Green:**
    - thomas.green@xcelenergy.com

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QUESTIONS